

ENGINE TECHNOLOGY

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Caterpillar's DOE "In-Cylinder Components" contract, with the objective of developing the technology for a heavy duty diesel engine with low emissions and a specific fuel consumption goal of 0.25 lb/bhp-hr, began eight years ago. Over the years, with significant DOE support, we have moved within striking distance of the program goal. It is important to note that the goal is as valid today as it was when it was first established. As an engine manufacturer, to remain competitive and meet our customers requirements, we are driven to develop a product that will reduce their owning and operating costs. In addition, in order to meet legislated emissions standards we are driven to pursue ways of making our products more sociable.

It is interesting to see how diesel engine efficiency has improved since Caterpillar produced its first diesel engine 65 years ago this month. Active performance improvement research programs have produced a steady improvement in efficiency. We find that historically, the advanced research engines demonstrate technology 5 to 10 years before the technology makes its way to production. Of course with more modern research analytical, design and test methods we hope to shorten the time between proof of concept and entry into production. Although much research work remains, we believe that with continued DOE support, the 0.25 BSFC goal is achievable.

It is also of interest to note the dramatic improvements that have been made in cleaning diesel engine exhaust. There has been a 67% reduction in NOx and a 90% reduction in Particulates since 1974. However, research to find the most cost effective methods of meeting ever more stringent emissions standard will require continued corporate and DOE funding.

Caterpillar's efforts to meet the DOE contract goal of a low emissions, 55% thermally efficient engine (LE-55) have relied heavily on a single cylinder engine for component performance and durability development. Using components developed to maximize their insulating capability and reduce friction, we have demonstrated a specific fuel consumption of 0.256 lb/bhp-hr. This technology has been designed into a multi cylinder LE-55 engine which is currently being assembled. High efficiency series turbochargers for the engine have been built and tested by subcontractor AlliedSignal. Testing of this engine will begin late this year. This engine utilizes air gap insulated pistons and exhaust port liners. Improved efficiency and reduced costs can be realized with additional research and development of thick ceramic thermal barrier coatings and cast ceramic insulation.

As we look to the future and a 50% efficient Clean Diesel 50 (CD-50) program, aimed at

production in the early 2000's, we must pursue a balanced approach to meet emissions, fuel economy and sociability objectives. Our programs to date have focused primarily on developing basic engine technology. We need to look more closely at the gains in emissions reduction that can be achieved by developing the fuel and must continue development of cost effective after treatment technology.

In summary, we find that our customers needs and the need to meet legislated emissions standards drives our pursuit of new engine technology. As noted earlier, diesel engine performance and emissions improvements have been a continually evolving process, however, much work remains to be done. We have a great opportunity to make more efficient engines that will benefit U.S. industry, our customers and our country. We will be successful in meeting the challenges we face if we continue to effectively leverage DOE funding, lab and human resource capabilities, as well as utilize the research expertise of academia. Finally, to maximize the impact of the research work we are doing on heavy duty diesel engines, we need to find effective ways of transferring this technology to light duty diesel engines.